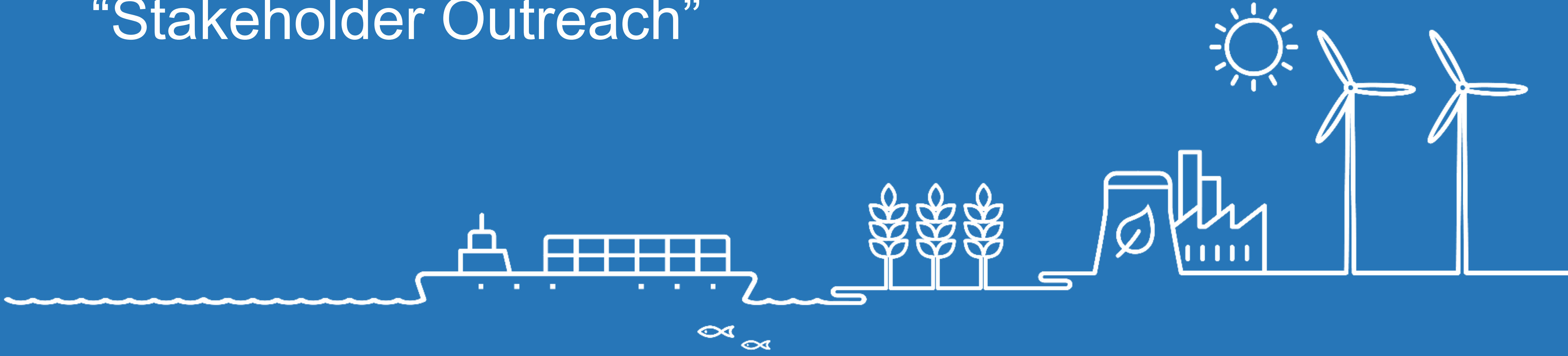
Yara Clean Ammonia

“Stakeholder Outreach”



November 2023

AMMONIA AS MOLECULE

For over 100 years, ammonia has been safely produced

For over 60 years ammonia has been safely shipped in bulk

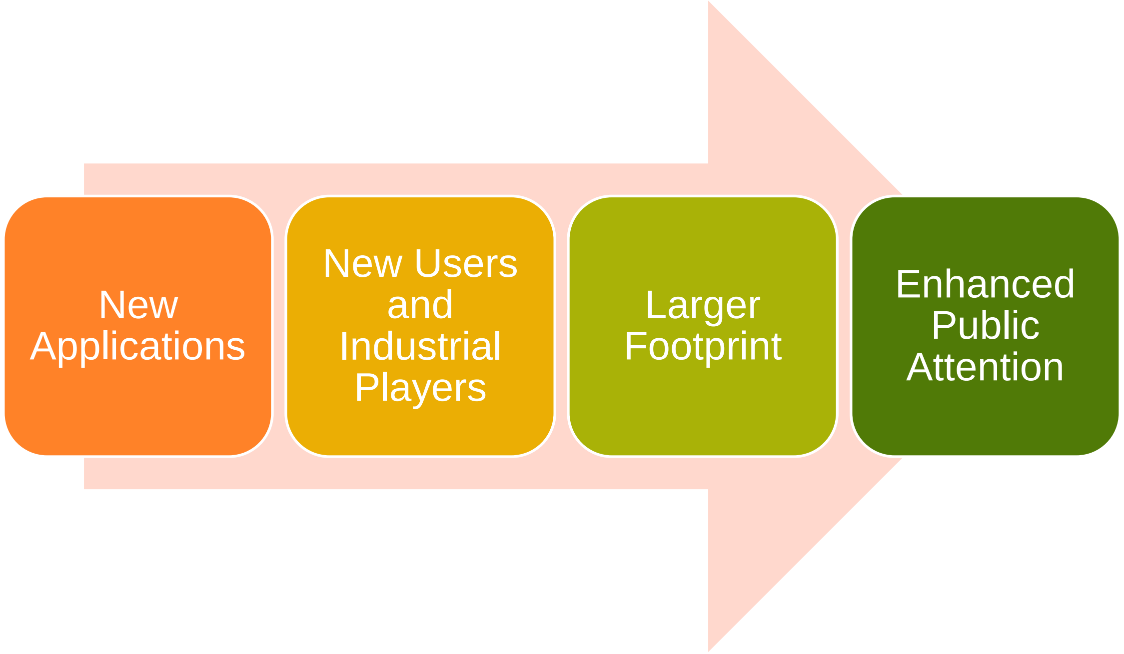
Ammonia is one of the most produced inorganic chemicals worldwide

There is already established infrastructure for its production, storage, and global transportation.

CURRENT CHALLENGE

End-use applications

- Fertilizer
- Industrial applications
- Shipping fuel
- Power
- Hydrogen carrier



Current situation requires non-traditional approach for stakeholder engagement and public education

CLEAN AMMONIA EXPLAINED

Clean Ammonia Explained

3 Why clean ammonia and why now?

An enabler of the green transition

Businesses can be a game changer to help ensure that we limit the global warming to 1.5 °C, and to ensure that the change is happening at the scale and pace necessary. Private sector is undertaking the investments and innovations needed for low carbon growth.

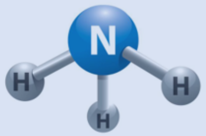
Hydrogen is the highway to decarbonization, and clean ammonia is the superior hydrogen carrier. Speed and scale is needed to get the costs down, helped by regulations and funding. Policy instruments, such as the European Green Deal and the US Inflation Reduction Act (IRA), are speeding up the pace of development towards a low carbon society.

Clean ammonia can help to transform hard-to-abate industries, such as the fertilizer industry, transportation and power generation. Clean ammonia is produced with low-carbon emissions, making it a suitable alternative to traditional energy sources.

The world currently consumes around 180 million tons of ammonia per year. Ammonia production accounts for around 1 percent of our global GHG emissions.[1] To meet net-zero targets, decarbonization of ammonia production must be developed.

What is ammonia?

A molecule of ammonia (NH_3) contains one nitrogen atom and three hydrogen atoms. Both are naturally present in our environment. The air we breathe is about 78 percent nitrogen. And hydrogen is the most abundant element in the universe.



About 80 percent of the ammonia produced is currently used in agricultural products such as nitrogen-based fertilizers. Ammonia is also used for industrial applications, for countless products that we use every day. Ammonia is commonly used as refrigerant in for example for ice skating rinks, food processing and ice cream factories. It is used on fishing boats to keep the catch fresh until it reaches the shore. It is also used as feedstock in the production of plastics and a variety of chemical and pharmaceutical compounds. The ammonia smell is well known in the society. Diluted in water, it is also used as a cleaner, in hair colour and other consumer applications.

Ammonia is an energy-efficient way to transport larger amounts of energy over long distances in less space. Ammonia has higher volumetric energy density than hydrogen, meaning that a bucket of ammonia actually contains more hydrogen than a bucket of hydrogen. 1 liter of hydrogen contains 8MJ, while a liter of liquid ammonia contains 13MJ, i.e. 60 % more.

Ammonia (NH_3) does not contain carbon, so it does not emit CO_2 during combustion. When it is produced with a low carbon footprint – which we will come back to – it is considered a future fuel for deep sea shipping and power generation.

[1] Ammonia Energy Association, US.

PURPOSE

Education: **Share insights to internal and external stakeholders about ammonia**

Alignment: **For all colleagues to be equipped with the same messages**

Efficiency: **Enabling us to reuse message**

Target groups

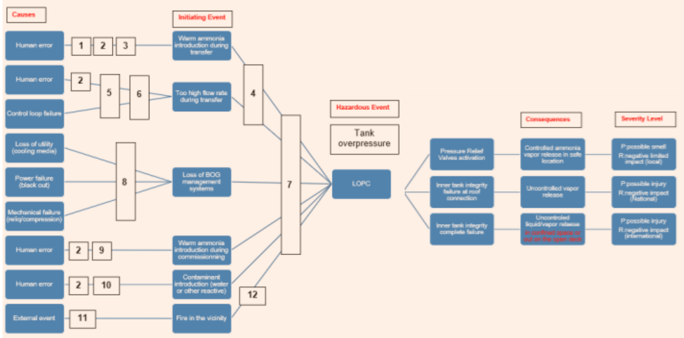
- Potential customers and partners
- Participants in outreach activities, fairs and conferences
- Journalists
- Politicians, regulatory bodies
- Maritime authorities, municipalities, state administrators etc.
- Investors
- NGOs
- The general public and local communities
- Internal Yara staff in YCA and Yara

Document that will answer all the main questions that stakeholders have about clean ammonia

AMMONIA GENERIC RISK SCENARIO’S

Building awareness on ammonia safety

Ammonia Generic Risk Scenario



Preventing barriers

1. Pre-transfer procedure with dedicated checklist
2. Operator specific training
3. SIS: High T trip (stop transfer operation)
4. SIS: High P trip (stop transfer operation)
5. SIS: High flow trips (stop transfer operation)
6. System design with safe max flow rate from pumps
7. BPCS high pressure vent to ARMS
8. Systems redundancies
9. Commissioning procedure
10. System design (isolated & dedicated)
11. System design (no combustible material)
12. Water deluge to reduce heat radiation

Key Objectives

- Identify critical events leading to ammonia loss of primary containment (LOPC), their associated causes and consequences.
- Identify existing barriers and discuss required barrier integrity.
- Integrate all knowledge and experience Yara has in ammonia system design and operations

STANDARDIZE EMERGENCY REPONSE

Ammonia specific emergency response standard practices to enhance the knowledge sharing among stakeholders to bridge the knowledge gap.

No reason to treat ammonia differently as compared to any other hazardous material already present

- Early detection of leakages
- Automatic isolation of large inventory
- Keep it liquid (collect/cover/recondense/etc…)
- Control the escaped gas (abate with water or disperse/dilute with ventilation)

Standard Emergency Response Practice

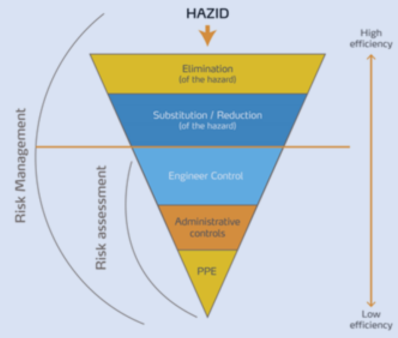


Figure 4-8 Risk control measure hierarchy

Suitable personal protective equipment (PPE) should be available depending on the level of exposure, as depicted in Figure 4-9.

Emergency responders who need to access contaminated area over a prolonged time, e.g. to closing valves, are recommended to wear a so-called hazmat suit that covers the whole body and is impermeable to ammonia. Self-contained breading apparatus is also likely to be required.

For operators dealing with ammonia, for example connecting the bunkering system, a lighter chemical suit should be sufficient to guard against ammonia leaks and splashes. A full full-face gas mask with ammonia removal cartridge is likely to be sufficient if the operator can quickly escape to a safe area.

Other staff, not dealing directly with ammonia may need to have an individual escape mask easily available.

Emergency response for prolonged exposure | Normal operation To be adjusted for escape possibilities | Escape mask to evacuate to the nearest gas tight room


Thank you for your attention!
Any questions?
Yara Clean Ammonia
YARA